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From the Editors

In this issue, we present two articles that each deal with a rare plant. When we hear a plant is rare, we often think it must be endangered, but this is not necessarily the case. Being rare and being endangered are not equivalent states. Rarity for a species may be quite normal. So, what does being rare, for a plant, really mean? This has been argued over a long period of time. Probably the most widely accepted classification of rarity is that of Rabinowitz, which reflects three spatial characteristics: population size, ecological specialisation and geographic range. Some authorities include the frequency of occupancy in suitable habitats. Temporal rarity also is a consideration. Some species are common following fire but become rare with time, as conditions change and become unsuitable - until after the next fire event.

Unfortunately, for many rare plants, being rare is because they are under some type of threat and face the potential of extinction. Yet, for a lot of these plants, we have no idea of the importance of their role in the environment. Nor do we notice their passing. It is pleasing, therefore, that we can present these two articles and highlight the need to be more aware of what is around us.

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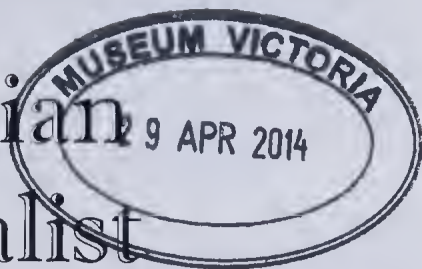
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Front cover: *Caladenia australis* Southern Spider-orchid. Photo by Gary Backhouse. See page 40.
Back cover: *Pomaderris vacciniifolia* Round-leaf Pomaderris. Photo by John Patykowski. See page 44.

Historical responses of distance between leaf teeth in the cool temperate rainforest tree Austral Mulberry *Hedycarya angustifolia* A. Cunn. from Victorian herbarium specimens

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Abstract

Distance between leaf teeth was examined in the cool temperate rainforest tree Austral Mulberry *Hedycarya angustifolia* A. Cunn. to determine whether this leaf character has the potential to be used as an environmental proxy. Photometric analysis was undertaken from Victorian herbarium-lodged specimens of *H. angustifolia* from 1852 to 2010. Regression analysis revealed no significant change in mean distance between leaf teeth in response to an increase of 0.9°C in mean annual temperature (MAT). From this preliminary analysis, distance between leaf teeth appears to be non-responsive to changes in MAT. It is possible that increases in MAT over the study period were insufficient to elicit a response in this leaf character, or that other environmental factors and/or intrinsic variation within this species may obscure any possible MAT signal. Future studies will be required to identify any probable drivers of this leaf character. (*The Victorian Naturalist* 131 (2) 2014, 36–39)

Keywords: Leaf teeth, *Hedycarya angustifolia*, mean annual temperature, Herbaria, environmental proxy

Introduction

Leaf morphology has long been found to respond to changing abiotic factors over environmental gradients in an attempt to maximise photosynthetic gains (CO₂ movement into the plant) and minimise transpirational losses (water loss from the plant via evaporation) (Bailey and Sinnott 1916; Givnish and Vermiej 1976). Changing abiotic factors such as increasing mean annual temperature (MAT) will increase transpirational losses and increase plant water stress, resulting in alteration to leaf form to reduce the effect of these stressors (Tricker *et al.* 2005). Altering the distance between leaf teeth may reduce transpiration rate by modifying the leaf boundary layer. The leaf boundary layer is a layer of static air over the leaf surface which provides a barrier to gas exchange (Schuepp 1993). Increasing the distance between leaf teeth does enhance boundary layer thickness and reduces transpirational losses by increasing the 'barrier width'.

If a leaf character responds in a predictable manner to an environmental variable, i.e. MAT, then this response could be employed as a proxy for that factor. Biological proxies have been successfully used to gain much information about previous climatic conditions, which may enhance our understanding of how future

climate change may impact current ecosystems (Wing and Greenwood 1993; Royer *et al.* 2009). Recent studies have found leaf teeth characters, such as teeth number, size and area, are responsive to temperature and water availability (Hinojosa *et al.* 2011; Peppe *et al.* 2011; Royer *et al.* 2009). Scarr (1997) demonstrated that mean distance between leaf teeth in Austral Mulberry *Hedycarya angustifolia* A. Cunn. responded significantly to temperature factors but, to date, there have been no published studies examining the potential application of this leaf character as an environmental proxy.

Herbarium specimens provide a valuable resource that allows the examination of historical responses in foliar physiognomy (leaf form) over multi-generational time-scales. If there is a historical change in distance between leaf teeth in *H. angustifolia* across years of collection and if this correlates to increasing MAT, then this relationship may be assessed in multiple species as a standard environmental proxy measure in palaeoclimatological investigations. The aim of this study is to determine if distance between leaf teeth in herbarium-lodged Victorian specimens of the cool temperate rainforest tree, *H. angustifolia*, demonstrates historical change

with particular focus on increasing MAT over the years of collection.

Methods

All leaf specimens were obtained from the National Herbarium of Victoria in Melbourne, Australia (MEL) spanning from 1852 to 2010. Sampling included creating a database for each herbarium sheet present in the MEL collections containing *H. angustifolia*. Information recorded from each herbarium sheet included (if available): sheet number, year of collection, latitude and longitude, elevation, branch tip present, flowers present and leaf number.

Due to limited research funding, the selection strategy was to sample one herbarium sheet per decade (if available) for the test species. Herbarium sheets were preferentially selected if a) sheets were from similar locations (to reduce genotypic variation), b) contained large numbers of leaves, and c) the specimen consisted of the branch tip with flowers present; which ensured that only sun leaves were sampled. Within each herbarium sheet, up to four leaves were photographed with a scale bar to be used for further photometric analysis (Fig. 1).

Images of sampled specimens were saved electronically as compressed TIFF files using the image conversion program Image Converter Plus. These TIFF images were loaded into ScionImage, an image analysis program, where the distance between every leaf tooth and its neighbour over the leaf margin were recorded in millimetres (mm). Individual distance measurements between teeth per leaf were recorded and

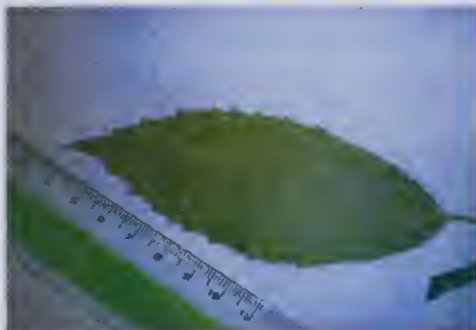


Fig. 1. An example leaf from a herbarium specimen of *Hedycarya angustifolia* used for photometric analysis. Photo by J Cocking 2012.

the overall mean distance between leaf teeth per herbarium sheet was calculated. To determine if mean distance between leaf teeth significantly altered in response to year of collection and MAT, least squares linear regression was conducted using Predictive Analysis SoftWare v20 software (SPSS Inc.). All statistical analyses were conducted at an alpha level of 0.05.

Results

Herbarium sheets of *H. angustifolia* spanning 12 decades were sampled from 1852 to 2010 (Table 1), which corresponded to an increase in mean annual temperature (MAT) of 0.9°C over the last half of the previous century (CSIRO and BoM 2007). Mean distance between teeth varied from 6.55 mm in 1852 to 6.03 mm in 2010, with a maximum reading of 7.73 mm in 1929 and a minimum value 4.81 mm in 1947.

Least squares linear regression analysis demonstrated no significant relationship ($P > 0.05$) between mean distance between teeth and year of collection over the 158-year sampling period (Fig. 2a). In addition, no significant change ($P > 0.05$) was found in mean distance between teeth when the dataset was trimmed to examine the 0.9°C increase in MAT since the 1950s (CSIRO and BoM 2007) (Fig. 2b).

Discussion

Mean distance between leaf teeth was found non-responsive across years of collection or to increasing MAT in herbarium-lodged Victorian specimens of *H. angustifolia*. Therefore, based on this current dataset, the hypothesis

Table 1. Collection year of sampled herbarium sheets of *Hedycarya angustifolia* and associated mean distance between leaf teeth (mm) \pm 1 standard error (S.E.).

Year	Mean	S.E.
1852	6.55	2.20
1888	7.00	2.00
1897	6.19	1.48
1901	5.87	1.74
1915	5.03	1.52
1929	7.73	2.42
1947	4.81	1.45
1952	6.06	1.56
1969	6.04	1.99
1979	6.76	1.62
2000	6.75	1.61
2010	6.03	1.11

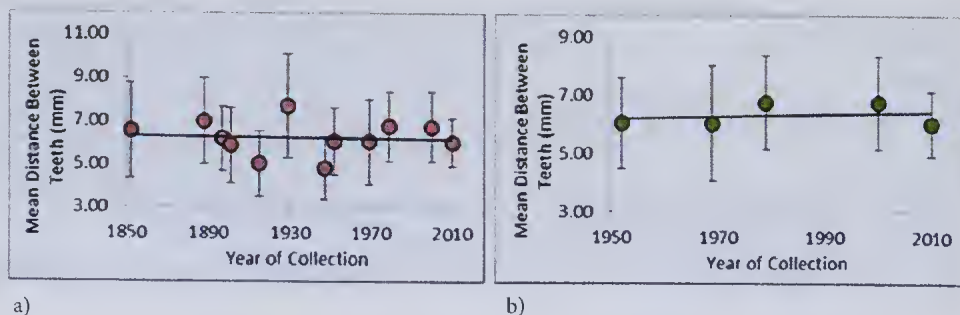


Fig. 2. Scattergrams with fitted linear trendlines for mean distance between leaf teeth versus a) year of collection from 1852 to 2010 ($y = -0.007x + 7.6027$, $R^2 = 0.0018$, $P > 0.05$) and b) year of collection from 1952 to 2010 ($y = 0.0044x + 2.4163$, $R^2 = 0.0698$, $P > 0.05$). Standard error bars ± 1 S.E.

that distance between leaf teeth would increase as a response to long-term increasing MAT can be rejected. It may then be inferred that there was no subsequent adjustment in leaf boundary layer width in response to this environmental stressor; however, when the dataset was trimmed to include only samples correlating to the 0.9°C increase in MAT since the 1950s the fitted trendline sloped upwards (Fig. 2b), indicating an increase in distance between leaf teeth, albeit insignificant. This lack of significant alteration to distance between leaf teeth may be attributed to, in part, the high degree of variation about the mean as can be seen from the standard error bar width (Fig. 2b).

Over the 158-year sampling period there is a large degree of scatter above and below the fitted trendline (Fig. 2a), which showed no significant change in distance between teeth over this temporal transect, a period that has experienced continual increase in climatic factors such as MAT and concentration of CO_2 (Etheridge *et al.* 1996; CSIRO and BoM 2007). This suggests that other environmental and/or intrinsic (within-species) factors may be the primary drivers controlling this leaf character. One collection variable that may impact upon leaf form is altitude at which the herbarium specimens were collected. Variation in altitude affects multiple environmental factors that influence leaf development, growth and photosynthetic potential (Crawford 1989; Scarr 1997). Environmental factors that alter with altitude are temperature, CO_2 contration, water and nutrient availability, soil type, wind speed

and light levels (Körner and Cochrane 1985; Woodward 1986; Foreman and Walsh 1993). Aspect is another factor that will influence water availability at high altitudes, particularly on the leeward side of a range in the rain shadow, and thus leaf form may be affected.

Intrinsic variation may also dampen any environmental signature in leaf form within a dataset. Intrinsic variation is influenced by genotypic variability (i.e. alterations to gene expression) which results in differing phenotypes (physical features of the leaf). Thus, the influence of genotypic variation may be more significant in determining leaf phenotype than environmental variables, with considerable genetic variation being observed within a single location and within a single tree (Beerling and Chaloner 1993; Fordyce *et al.* 1995; James and Bell 1995). The lack of a significant alteration to the distance between leaf teeth in *H. angustifolia* to increasing MAT may be attributed to the large genotypic variation in this species.

Variation in environmental factors associated with altitude at which specimens grew, and intrinsic variation, may be mitigated by appropriate sampling strategies, that is, by sampling specimens collected from the same area at a similar elevation; however, an inherent problem in using herbaria is that the earlier lodged specimens lack comprehensive collection information on herbarium sheets. As a result, a researcher cannot completely remove all confounding variables associated with varying collection locations when using herbaria to establish a temporal transect.

Future research to establish if distance between leaf teeth in *H. angustifolia* can, in fact, respond to increasing MAT would be to employ growth chambers where plants can be reared in a controlled environment in which only temperature has been varied. Sampling of herbaria may be improved by trimming the dataset to include only herbarium sheets of known locations and altitude to reduce the potential impact of intrinsic variation upon this leaf character. Also, sampling herbaria over a latitudinal gradient (i.e. from Tasmania to Queensland) will establish a change in MAT of approximately 4°C, which may be sufficient to elicit significant alterations to leaf form. Finally, increasing the leaf number sampled per herbarium sheet may reduce scatter about the mean and, potentially, could result in a significant response being observed in distance between leaf teeth.

In conclusion, distance between leaf teeth from herbarium-lodged Victorian specimens of the cool temperate rainforest tree, *H. angustifolia*, does not appear to track changing MAT. But when the dataset was trimmed to include a period of rapid MAT increase, there was a positive trend with distance between leaf teeth, although not statistically significantly. Therefore, there may still be the potential to employ this leaf character as an environmental proxy but further research will be required to validate this.

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The discovery of the Southern Spider-orchid *Caladenia australis* G.W. Carr in Tasmania in 1968 and the later searches

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Abstract

A single plant of the Southern Spider-orchid *Caladenia australis* G.W. Carr was collected beside Lady Barron foreshore on Flinders Island in November 1968. It remains the sole Tasmanian record to date. The species is scheduled under the Tasmanian *Threatened Species Protection Act 1995* as endangered. Its Tasmanian habitat is described and the later searches for the species are dealt with. The restricted occurrence of four other Spider-orchids, each also found just once on Flinders Island, is detailed. (*The Victorian Naturalist* 131 (2) 2014, 40–43)

Key Words: Flinders Island, endangered and extinct Tasmanian orchids

Locality and Habitat

Lady Barron is the south-eastern village of Flinders Island. Its coast is mainly granite and the land rises gradually to the twin knolls—also granite—of Vinegar Hill. Both are about 80 m high. Parts of the hill have a veneer of very old, planed-down sand dunes.

The foreshore of the core of the village is granite and Water-rock Point—at the western end of Yellow Beach—has a large, low granite outcrop that rises only about a metre above the local slope. Most of its margin shelves gradually and so carries soil that starts as very shallow and then increases in depth to a varying degree. For a period the outcrop was prepared as a water-rock but its small dam was destroyed when a bulldozer cleared the rock's southern base.

The fringing vegetation—where it has not been destroyed by later clearing—is mainly Rock Tea tree *Kunzea ambigua*, a hardy shrub that tolerates the often drouthy conditions of the shallow edges of granite outcrops on Flinders and Cape Barren Islands. The rock and its fringe are about 20 by 15 m. A single plant of a Spider-orchid, *Caladenia* sp., was collected on an edge of the outcrop on the 9 November 1968. It was recorded at the time as 'not *clavigera*'. It had one flower and the leaf had been eaten. There were no shrubs in the understorey of the Rock Teatree. The extra orchids present were the Mayfly Orchid *Acianthus caudatus* and Maroonhood *Pterostylis pedunculata*. The other herbs were Small Poranthera *Poranthera microphylla*, Austral Carrot *Daucus glochidiatus*, Errienellam *Drosera auriculata*, Silvery Hair-

grass *Aira caryophyllea*, Flat-weed or Bear's-ear *Hypochoeris radicata* and a Fescue *Vulpia* sp. The asterisks mark the exotic plants. The Rock Teatree gave way to Paperbark *Melaleuca ericifolia*, Smooth Teatree *Leptospermum laevigatum* and Cape Barren Pine *Callitris rhomboidea* in the deeper soil just west of the edge of the outcrop.

The specimen from Lady Barron became the Southern Spider-orchid *Caladenia australis* when Carr (1991: 2-3) named the species (Fig. 1).

The Searches of Vinegar Hill

As there was no later trace of the Southern Spider-orchid at the remembered site, the author decided to search Vinegar Hill as a last resort. Only six of the 15 rambles to the hill between 1997 and 2000 were made at a time when *caladenias*, other than the common Pink Fingers *Caladenia carnea*, could be determined. Larger leaves, including those of Spider-orchids, were found. The commonest leaf belonged to the Green-comb Spider-orchid *Caladenia dilatata*. About a hundred plants were examined when flowering or when their buds were large enough to be examined. They occurred where the understorey was open or where shrubs were dominant but not dense. These spots included the mid south-western slope of the western knoll, the northern slope of both knolls and an area of gently sloping stone and shallow soil, with Rock Teatree, on the upper eastern side of the summit's knoll.



Fig. 1. Southern Spider-orchid *Caladenia australis*. Reproduced with permission from Walsh and Entwistle (1994: 783).

Pink Fairies *Caladenia latifolia* formed a tiny patch, of about 12 plants, on the upper south-western slope of the western knoll. Hare's Ears *Leptoceras menziesii* occurred in a small pocket of shallow soil of a swelling outcrop of the mid south-western slope of the western knoll and in the shallow soil of two outcrops that just broke the surface on the upper northern slope, and one on the upper southern slope, of that knoll. The final site was amongst scattered small granite blocks on the mid northern slope of the hill. The only prior record of Hare's Ears for Flinders Island was a collection made beside North Pats River on the author's bush block after the bush-fire of late January 1966.

The site in 2009

The water-rock had been visited at least eight times since the collection was made but it was not until late in 2009 that the field notes, and sketch-map, of 1968 were examined carefully. Before that the remembered site and vicinity of the Southern Spider-orchid, some distance away from the actual site, were checked.

It seems likely that the water-rock had been burnt a few years prior to the visit of late 1968.

The sketch-map drawn then showed the stone to be more extensive than is obvious now. The Rock Teatree had reached over six metres in height by 2009. There was no trace of any Spider-orchid plants within 10 metres of the mapped site. Green-comb Spider-orchids were found about 20 metres east in shallow soil under Rock Teatree. This species was sketched in the field notes of 1968 and has been recorded on many occasions since then.

At the time of collection, the water-rock was part of a Crown land block between Pot Boil Road—the first road to the north—and the foreshore. It was then leased and cleared except for the rock and most of its fringe. Subsequently the block was subdivided in three, and sold, by the Lands Department. The rock forms the southern end of the central block. Its south-eastern edge was cleared when a vehicular track was run to the west at about a third of the way up from the outcrop's southern end.

The rock and its fringing Teatree had the richest orchid flora that the author has found on any small area of the 100 islands visited so far in Banks and eastern Bass Straits. The 18 species are listed in the Appendix to preserve, on paper, the names of plants that are all likely to perish through clearing—some wood-cutting has been done recently—and the continuing influx of weeds.

The final searches

Thirteen visits were made to Water-rock Point between 18 July and 2 December 2012. Seven of the eight sites of Spider-orchid leaves were novel to the author, and all were checked repeatedly. The number of plants that could be identified at a site ranged from one to 32. The smallest site held five leaves and two budding plants. The author covered the latter with branches but, during a later inspection, one lot was not replaced carefully and the plant's stem and bud were eaten. The other plant flowered later. Eighty-two plants could be determined and all were Green-comb Spider-orchids. Twenty-two other plants formed only leaves. A further four formed stems and buds but the latter were so small when the plants shrivelled that they could not be determined. One plant that might have developed was nibbled. Three budding plants that were not covered beside

one site disappeared without the slightest trace. The identified plants greatly outnumbered the others and so it seems likely that the latter were probably the same species.

Water-rock Point was visited on 26 October, and twice in late November 2013. A few novel sites of spider-orchids were found, mainly on the foreshore. As well, several known occurrences had more flowers than last year. The new plants that could be named totalled 46 and all were Green-comb Spider-orchids. The closed flowers of two plants could not be determined. One was in a group of six flowering Green-Comb Spider-orchids. The other was part of a small patch of one flowering Green-comb Spider-orchid and eight spider-orchid leaves. The new records brought the number of plants that could be identified in 2012 and 2013 to 128. So the Southern Spider-orchid is still elusive and that seems unlikely to change.

The Australian mainland range of the Southern Spider-orchid

In Victoria, according to Backhouse and Jeanes (1995: 56), the species: 'Favours woodlands and open forests, usually with a heathy understorey. Substrates are well-drained sand and clay loams.'

Later Jeanes and Backhouse (2006: 49) noted that the orchid occurs '...in coastal and hinterland areas of southern Victoria, east from Port Campbell, growing in heath, heathy woodland and lowland forest.' They added that it is a '...rare, poorly known orchid ...'

Discussion

Spider-orchids, other than the Blunt-tipped Spider-orchid *C. clavigera*, seem to be either very rare or very restricted in their range on Flinders Island. The author has found the Green-comb Spider-orchid at only two sites away from the Lady Barron-Vinegar Hill area. Several populations were recorded on the old consolidated dune that forms the northern shore of Bennetts Lagoon. There are also about 50 plants amongst Rock Teatree on shallow soil beside the track to Strzelecki Peaks where it passes through the freehold land by the western boundary of Strzelecki National Park.

Lady Barron foreshore was first visited by the author in September 1965 and the very sparse

notes—several common orchid genera were not even known by him at that time—include a Spider-orchid. The specimen was examined by JH Willis at the National Herbarium of Victoria on 6 June 1966. He remarked that it was 'Apparently *Caladenia patersonii* (Common Spider-orchid), but a poor, battered specimen. If there were clubs on the end of the sepals, it would be a form of *C. reticulata*'. CSIRO botanist Dr Mark Clements agreed with this assessment when he examined the specimen after it was lodged at the Australian National Herbarium (CANB) (Jo Palmer, pers. comm., 22 November 2012). This fading specimen was another reason for the searches of Water-rock Point in late 2012. As the Southern Spider-orchid *C. australis* could be assigned to a form of *C. reticulata*, the September 1965 specimen might have been the former species. There are no certain records of *C. patersonii* for Flinders Island (Jones *et al.* 1999).

Three other Spider-orchids have been found just once on Flinders Island. Archdeacon Atkinson collected Daddy Long-legs *Caladenia filamentosa* and the Tailed Spider-orchid *C. caudata* in October 1947. The local clergyman HG Biggs found the Heart-lipped Spider-orchid *C. cardiochila* in the same month. His specimen remains the sole Tasmanian record to date and—being found so long ago—the orchid is scheduled, under the Tasmanian *Threatened Species Protection Act 1995*, as extinct. All three labels give the localities as just 'Flinders Island'. This is disappointing as most of the island had been named by then. The specimens are held under number 1947B by the Queen Victoria Museum and Art Gallery in Launceston. As a child, Jan Cooper, of Flinders Island, made one excursion with the collectors. She can recall them becoming very excited about an orchid found west of The Long Straight in the Blue Rocks district. She does not recall the vicinity as being uncleared bush (Jan Henning, pers. comm. 12 April 2013). Jones *et al.* (1999) mapped the three 1947 specimens at the same spot in north-eastern Flinders Island but noted only that the actual site of the Heart-lipped Spider-orchid is unknown.

The Status of the Southern Spider-orchid

The Southern Spider-orchid is still known for certain by just the single plant collected near

Lady Barron foreshore in November 1968. The species is scheduled, under the *Threatened Species Protection Act 1995*, as endangered in Tasmania. If it is not found again by November 2018, it will be classed as extinct in the State. On present indications, it seems likely to attain that regrettable status.

The Specimen

9.xi.1968, Beside Lady Barron foreshore, Flinders Island at 0606594, 5547886; 40° 12' 45.7", 148° 15' 09.5" (Datum: AGD66; estimated error: 5 metres). John Whinray C 1968, CANB 342227.

Acknowledgements

Maureen Christie provided support and assistance from 1967 to 1972. The 16 visits of 2012 and 2013 to Lady Barron foreshore were all made using a vehicle kindly lent by some members of the Liapota Co-operative. Jo Palmer, of CANB, supplied various details

about my specimens of the Southern Spider-orchid and *Caladenia patersonii* / *reticulata*. Jill Thurlow, of MEL, forwarded several useful photocopies. Dr Mark Clements, of the Centre for Australian National Biodiversity Research, and Jeffrey Jeanes, of MEL, determined some orchid specimens from the water-rock. The many drafts of this note were typed at the Online Access Centre on Flinders Island.

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Appendix: A list of the orchids of Lady Barron Water-rock

Note that the many plants of *Caladenia latifolia* were wiped out when the rock's dam was destroyed. The species has not been found elsewhere on Water-rock Point. There is now no trace of either a *Corybas* sp. or a *Cyrtostylis* sp. at or beside the water-rock. The species that survive on the point's foreshore are listed in their stead. Before the local record was made, *Thelymitra imbricata* was assessed as endemic to the Midlands region of the Tasmanian mainland (Jones *et al.* 1999: 273).

Acianthus caudatus
Acianthus pusillus
Caladenia australis
Caladenia dilatata
Caladenia latifolia
Corybas fimbriatus
Cyrtostylis robusta
Diuris orientis
Microtis arenaria

Pterostylis concinna
Pterostylis melagramma
Pterostylis nutans
Pterostylis pedunculata
Thelymitra arenaria
Thelymitra flexuosa
Thelymitra rubra
Thelymitra juncifolia
Thelymitra imbricata

One Hundred Years Ago

The Mallee: Ouyen to Pinnaroo.

Botanical notes

By A.D. HARDY

At 9.30 we were in a fine basin to the south-west of Mount Gnarr, where, in a shallow catchment, we found water, with Cane-grass and Nardoo. Here were signs of improved water storage—old but unmistakable traces—and we felt we were on the eve of further discovery. The depression was fringed with mallee scrub and pine. Ascending the further rim, we came upon the old ruins of a hut and pine-log yards, with abundant thistles, and sheep-droppings in and about the place. Here was, about 30 years ago perhaps, an out-station of a homestead on the Murray, but abandoned through failure of the water supply. "Old hut and yards" was the name for a point on the Sunset Track where we had camped the previous night, and where, according to legend, some ruins had once been seen.

From *The Victorian Naturalist* XXX, p. 157, January 8, 1914

A review of the conservation ecology of Round-leaf Pomaderris *Pomaderris vacciniifolia* F. Muell. ex Reissek (Rhamnaceae)

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Abstract

Round-leaf Pomaderris *Pomaderris vacciniifolia* F. Muell. ex Reissek (Rhamnaceae) is a Victorian endemic shrub listed as threatened under the *Flora and Fauna Guarantee Act 1988* and critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999*. A review of the available literature for *P. vacciniifolia* indicated most information is anecdotal or found in unpublished works. Better understanding of the ecology of *P. vacciniifolia* may help explain why it is vulnerable, and enhance future management. Future research should focus towards better understanding of *P. vacciniifolia* habitat, reproductive ecology, seed dispersal mechanisms and competitive ability and how these compare with more common sympatric congeners, to determine whether any differences could explain the relative success of these species. Targeted searches for this species on public and private land are warranted to reveal additional populations and fully appreciate the distribution of this species. (*The Victorian Naturalist* 131 (2) 2014, 44–51)

Keywords: *Pomaderris vacciniifolia*, Rhamnaceae, conservation ecology, threatened species, seed dispersal

Introduction

Within Australia, few studies explicitly explain causes of rarity or uncommonness in plants. Often, there is little other than anecdotal information or unpublished literature available concerning their ecology, which can be difficult to access. This is the case for Round-leaf Pomaderris *Pomaderris vacciniifolia* F. Muell. ex. Reissek (Rhamnaceae), a Victorian endemic species. The objective of this paper is to collate available information for *P. vacciniifolia*, to highlight deficiencies in current knowledge and to provide direction for future research.

Pomaderris vacciniifolia (Fig. 1) is a slender shrub with weak spreading branches, growing to a height of 4 m (Walsh 1999; Costermans 2009). Its branchlets are greyish and covered in stellate trichomes, with elliptic to broad-elliptic leaves 8–22 mm long (usually 12–15 mm) and 6–13 mm wide (usually 8–10 mm) (Walsh 1999), with entire margins and an obtuse tip and base (Fig. 2). Stipules are deciduous and 1.5–2 mm long; the upper leaf surface is dark green, smooth, glossy and glabrous; the lower surface is greyish due to a fine, dense layer of minute stellate trichomes, with occasional, larger, rusty, stellate trichomes (Fig. 3). It produces small creamy-white flowers on pedicels 2–3 mm long (Fig. 4), with deciduous sepals 1.5–2 mm long that are pubescent on the lower (outer) surface

(Fig. 5), and quickly deciduous spatulate petals to 1.5 mm long (Walsh 1999). Flowers are arranged in axillary, hemispherical or pyramidal panicles, 10–40 mm long and wide. Small



Fig. 1. Population of *Pomaderris vacciniifolia* at Chum Creek, Victoria.



Fig. 2. Lower (a) and upper (b) surface of *Pomaderris vacciniifolia* leaves.

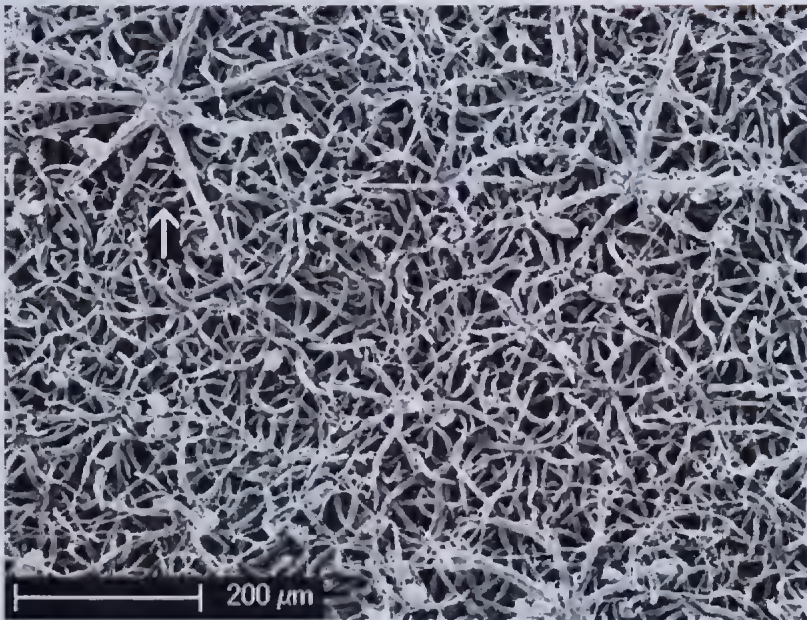


Fig. 3. Scanning electron micrograph of the lower leaf surface of *Pomaderris vacciniifolia* showing a dense covering of minute stellate trichomes, with the occasional larger, rusty stellate trichome (arrowed).



Fig. 4. *Pomaderris vacciniifolia* flowers displaying the (a) pedicel, (b) sepal, (c) petal, (d) stamen and (e) style.

bracts that subtend the flowers are deciduous (Walsh 1999). The calyx below the free part of the sepals is approximately 0.5 mm long. The ovary is half-superior to superior (Walsh 1999) and covered with stellate trichomes. The style is tripartite in the upper part (Fig. 6). Fruits are small, globular capsules to 2 mm wide (Walsh 1999), containing up to three hard, glossy, black seeds (J Patykowski pers. obs.).

Conservation status

Pomaderris vacciniifolia is listed under the *Flora and Fauna Guarantee Act 1988* as a threatened species. Under the *Advisory List of Rare and Threatened Plants in Victoria* (Department of Sustainability and Environment [DSE] 2005), it is assigned a conservation status of vulnerable. In January 2014, it was listed as critically endangered under the Environment Protection and Biodiversity Conservation Act 1999.

Geographic distribution

Remaining wild populations of *P. vacciniifolia* predominantly occur in often fragmented stands, throughout damp sclerophyll forest in the upper catchments of the Yarra, Yea and Plenty Rivers in Victoria in an area bounded

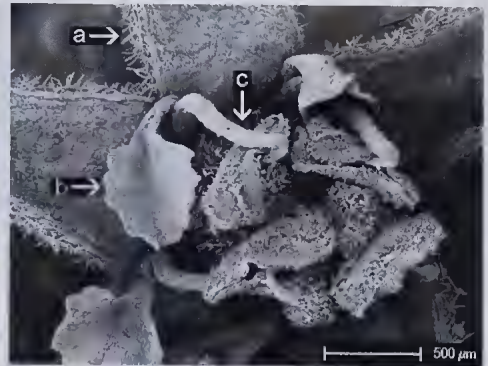


Fig. 5. Scanning electron micrograph of *Pomaderris vacciniifolia* flower showing the (a) glabrous adaxial surface of sepals, (b) petals and (c) stamen. Note the pubescence on the lower (outer) surface of sepals.

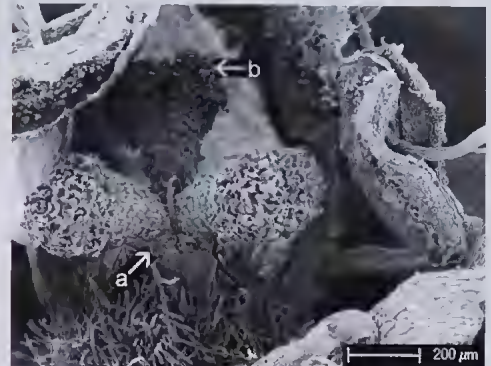


Fig. 6. Scanning electron micrograph of *Pomaderris vacciniifolia* flower showing the (a) tripartite style and (b) stigma.

by Healesville, Flowerdale and Eltham (Walsh 1999; DSE 2013a) (Fig. 7). Historical records indicate *P. vacciniifolia* occurs around Tyers and the Toongabbie–Cowwarr district (DSE 2013a), although records are few and dated, and its current presence requires ground-truthing. A small population was recently discovered at Bunyip Streamside Reserve, in West Gippsland (M Dell pers. obs.). It occurs within the Highlands–Southern Fall, Highlands–Northern Fall, Central Victorian Uplands and Gippsland Plain bioregions.

Remaining wild populations are found on ridgelines in moist forests and on lower slopes in hilly foothill country, extending occasionally into drier forests at lowland sites, elevations ranging from 40 to 550 m (Walsh 1999; Cam-

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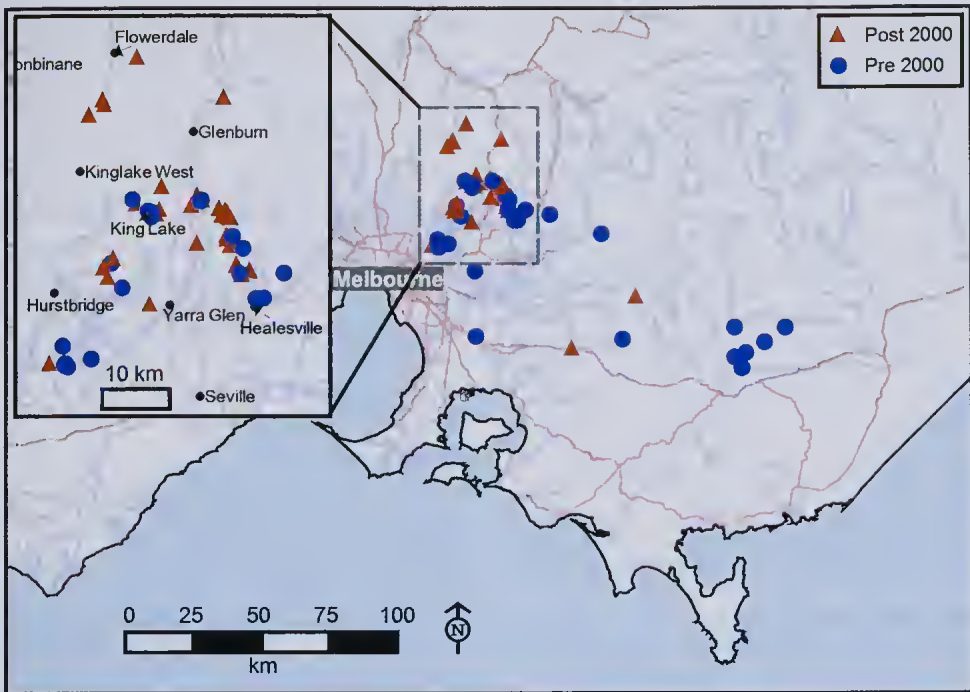


Fig. 7. Distribution of *Pomaderris vacciniifolia* records. Data Source: 'Victorian Biodiversity Atlas' © The State of Victoria, Department of Environment and Primary Industries (2013), and Council of Heads of Australasian Herbaria (2013).

eron 2006; DSE 2013a). Based on its known distribution, *P. vacciniifolia* is generally confined to soils derived from Silurian or Devonian marine sediments (usually sandstone or mudstone), although some lowland populations occur on alluvial soils (Douglas and Ferguson 1988; DSE 2013a).

Optimum conditions for this species appear to occur at elevations above 300 m with 800–1000 mm annual rainfall, where individuals seem to exhibit faster growth, reach reproductive maturity when younger and are longer-lived than plants growing at lower elevations and in drier conditions (Cameron 2006). Ecological Vegetation Class modelling by the DSE (2013) indicates that populations found under these conditions are associated with Damp Forest and Herb-rich Foothill Forest. These Ecological Vegetation Classes (EVCs) include the dominant canopy species Mountain Grey-gum *Eucalyptus cypellocarpa* L.A.S.Johnson, Messmate Stringybark *E. obliqua* L'Her., Narrow-

leaf Peppermint *E. radiata* Sieber ex DC. subsp. *radiata* and Manna Gum *E. viminalis* Labill. subsp. *viminalis*. Less optimal habitat occurs on lowland sites of 40 to 300 m elevation, with 650–800 mm annual rainfall. The DSE (2013b) modelled EVCs of these areas are Valley Grassy Forest, Creekline Herb-rich Woodland or occasionally Grassy Dry Forest (DSE 2013b). The dominant tree species for these areas are Broad-leaf Peppermint *E. dives* Schauer, Bundy *E. goniocalyx* F.Muell ex Miq., Red Stringybark *E. macrorhyncha* F.Muell. ex Benth. subsp. *macrorhyncha*, Yellow Box *E. melliodora* Cunn. ex Schauer, Red Box *E. polyanthemus* subsp. *vestita* L.A.S.Johnson and K.D.Hill, or on lower slopes and terraces *E. viminalis* subsp. *viminalis* (Cameron 2006; DSE 2013a). The recently discovered population at Bunyip Streamside Reserve was found growing in the EVC Swampy Woodland (M Dell pers. obs.), which includes the dominant canopy species Swamp Gum *Eucalyptus ovata* Labill. There have been no other

observations of *P. vacciniifolia* confirmed from this vegetation type; however, the Kooweerup Swamp and vegetation at its interface with surrounding land is much depleted (Yugovic 2011), so *P. vacciniifolia* may have been more widespread and frequent in this region.

Life expectancy

The estimated maximum life expectancy of *P. vacciniifolia* in wild populations is 35 to 42 years in lowland elevations and potentially 67 years or greater at higher elevations, which are considered to provide optimum conditions (Cameron 2006). The oldest recorded specimen, found in Castella, was presumed to have germinated following the 1939 bushfires and was alive up until 2006 (Cameron 2006). Natural mortality of plants has been observed from 10 years or more following germination, although natural mortality and senescence may occur much later under optimum conditions (Cameron 2006).

Flowering and reproduction

Pomaderris vacciniifolia flowers from September to November. Under dense shade, *P. vacciniifolia* may show poor growth and flower production and seed set may not occur (Cameron 2006). Plants growing under optimum conditions may reach maturity earlier than when grown under less optimal conditions. Flowering and successful seed set were observed as early as two years after germination following fire (J Patykowski pers. obs.).

Insects are believed to be the primary pollinators of this species and hoverflies have been observed visiting flowers (Cameron 2006). The species emits a slight nocturnal fragrance that may attract nectar-feeding moths, which also have been suggested as possible pollinators (Cameron 2006). It is unknown if this species can self-pollinate.

Pomaderris vacciniifolia has small seeds that mature around mid-December and early January, and are released from their capsules over this period (Cameron 2006). The species is a prolific seeder, with a single plant capable of producing thousands of seeds (J Patykowski pers. obs.).

Response to fire

The only documented detail about the fire response of *P. vacciniifolia* comes from Cameron

(2006). He suggested that *P. vacciniifolia* is a useful key fire response species, adapted to fire intervals of 15 years with a likely minimum of 10 and maximum of 25 years. Fire typically leads to mortality due to the thin, fire sensitive bark of this species. There is no record of post-fire resprouting. The species is an obligate seed regenerator and there is no record of other vegetative reproduction. Obligate seed regenerators from fire-prone regions often have seed that persists in soil seed banks for long periods of time, from several decades to hundreds of years (Baskin and Baskin 1998), and are adapted to a range of fire-related cues to promote germination (Paula and Pausas 2008).

Seed dispersal

Studies of the persistence of *P. vacciniifolia* in the soil seed bank have not been undertaken; however, the semi-hardened seeds are suspected to remain viable in the soil for at least 20 years (D Cameron pers. comm. 2013).

Attached to the small seeds of *P. vacciniifolia* is an elaiosome, an oil-rich structure, which suggests a likely adaptation for myrmecochorous (ant) dispersal (Fig. 8). Such seed dispersal is typical for Australian *Pomaderris* species (Berg 1975; Lengyel *et al.* 2009, 2010; Beaumont *et al.* 2011).

Germination

Successful recruitment of *P. vacciniifolia* in the wild rarely has been observed except after fire (Cameron 2006). Mass recruitment of *P. vacciniifolia* was observed following fires in 2009 at Chum Creek and Castella (S Meacher pers. comm. 2012) and following experimental burning of Lowland Forest in Eltham (C Beardsell pers. comm. 2012). Just and Beardsell (2011) observed mass recruitment of many rare flora species in Kinglake National Park, with some species reaching their largest population numbers in decades. This included *P. vacciniifolia*, suggesting that fire is a requirement for a significant recruitment event within a population. Indeed, the seeds of many other species of *Pomaderris* germinate *en masse* following fire (Warcup 1980; Turner *et al.* 2005; Haines *et al.* 2007).

Pomaderris vacciniifolia also is thought to have a low tolerance for competition in low light conditions, and successful recruitment

may not occur under dense shade (Cameron 2006). This again suggests a recruitment adaptation to changed site conditions due to landscape scale vegetation disturbance caused by fire, particularly through canopy reduction and reduced competition; however, recruitment also may be promoted by canopy opening and soil disturbance. Some small populations are found along roadsides, beneath power cables and in forest clearings, where the canopy has been opened and soil disturbance has occurred (Cameron 2006). Recruitment under these circumstances has occurred in the absence of fire. This is not atypical, as many plant species have seeds which must be brought to the soil surface, or require canopy openings to germinate (Baskin and Baskin 1998). In either case, seeds may be adapted to high- or low-temperature cues for germination (Baskin and Baskin 1998), or increased exposure to light, where photoreceptors in seeds, such as phytochromes, act as cues for a hormonal response signalling germination (Seo *et al.* 2009). Others have postulated that a break in the recent drought has prompted the germination of many species, including *P. vacciniifolia*, suggesting that long-term weather patterns could be linked to any decline in populations (D Cameron pers. comm. 2012; L. Smith pers. comm. 2012).

Threats to populations

Evidence suggests that *P. vacciniifolia* once occupied a much wider range; there appear to have been more populations around west Gippsland over the past several decades (DSE

2013a), which may have declined due to forest management practices, changed fire regimes or other disturbances. South-eastern Australia is thought to have supported a hyper-diverse sclerophyll flora during the early Pleistocene, with diversity declining during glacial-interglacial climate cycles throughout middle and late Pleistocene (Sniderman *et al.* 2013). It is possible that *P. vacciniifolia* is a relict species declining in extent throughout the Holocene, as has been suggested for other species of Rhamnaceae, including several *Spyridium* species from Tasmania (Coates and Kirkpatrick 1999).

Prior to European settlement in Australia, the major cause of natural mortality for mature *P. vacciniifolia* is likely to have been wildfire, and the survival of seedlings germinating after wildfires probably was limited only by browsing of young plants by native herbivores (Cameron 2006), and intra- and interspecies competition. Land clearing poses a major threat to remaining populations. The forests associated with larger populations are relatively contiguous; however, their condition is patchy. This is predominantly due to housing development, associated fire management practices and the installation of roads and fire breaks throughout the range of *P. vacciniifolia*.

Further threats to current populations are likely to include browsing from native and introduced herbivores, or senescence following an extended absence of fire (Cameron 2006). Successful recruitment of *P. vacciniifolia* in the wild currently appears limited to areas that have been burnt recently during wildfire or deliberately managed for post-fire recruitment at optimal fire frequencies (Cameron 2006; Just and Beardsell 2011). Protection from browsing seems to enhance the establishment of some populations (J Patkowski pers. obs.). Competition from weeds has been suggested as a key factor limiting successful recruitment to mature status in the wild (Just and Beardsell 2011), although competition from dense undergrowth of *Tetrarrhena juncea* R.Br. and other native species is likely to be more influential at most known populations (M Dell pers. obs.). This was noted in areas where disturbance such as fire was infrequent.

Tall, exposed individuals are prone to blowing over in strong winds because of their shallow root system (S Meacher pers. comm. 2012).



Fig. 8. Scanning electron micrograph of *Pomaderris vacciniifolia* seed with elaiosome (arrowed).

Severe insect damage also has been noticed on some specimens (J Patykowski pers. obs.). As this species appears to favour canopy openings for recruitment, some populations are found along roadsides and under power lines, thus, damage from vegetation slashing and weed spraying also threatens some remaining populations. In many areas, the soil seed bank is likely to have become depleted of *P. vacciniifolia* due to granivory, grazing of reproductively immature plants and changes in fire regimes, either through absence of wildfire and subsequent senescence of mature individuals, or due to over-frequent burning (Cameron 2006).

Directions for future research

Better understanding of the ecology of *P. vacciniifolia* is likely to explain why it is a vulnerable species and thus aid the development of appropriate management recommendations to ensure its long-term survival.

It is unclear why *Pomaderris vacciniifolia* should be restricted in range when the forest types with which it is most commonly associated are widespread and represented by a broad range of ages and quality. Given the diversity of *Pomaderris* species in Victoria, there are opportunities for rare-common contrasts with *P. vacciniifolia*. This could include experimental testing for limiting factors such as morphology, physiology, anatomy and fecundity (see Baskin and Baskin 1998; Beville and Louda 1999; Murray *et al.* 2002).

A more integrated approach to identifying factors important for a species presence can be gained by constructing a habitat model, to both compare theoretically relevant landscape and site predictors and map the extent of areas where *P. vacciniifolia* potentially could occur. The modelling process can identify important elements of *P. vacciniifolia* environment, which then can be appropriately considered in management prescriptions, such as the protection of critical habitat. There are also opportunities to undertake a detailed analysis of species associations as other species' presence may be used as a surrogate for habitat suitability.

Understanding how environmental cues for seed germination operate within *P. vacciniifolia* may explain why this species has been contracting in range. Identifying such a cue

and whether or not the cue has changed in frequency or intensity over time (e.g. alteration of a disturbance regime such as fire) may facilitate appropriate management for this species. When preparing pre-burn planning documents for controlled burns, an enhanced knowledge of the fire ecology of this species may influence decisions of when to burn, what intensity to use and what fire frequency is appropriate, and thus could facilitate determination of appropriate regimes.

This species may be contracting in range because of a limited ability to spread seeds into uncolonised or previously colonised areas, due to poor dispersal mechanisms or through the loss of a dispersal vector. Examining the mode by which seeds are dispersed and the distances seeds travel from parent plants may help to identify, at least, why this species has not been extending its range.

Further areas of particular research interest could include the effects of pathogens, herbicides, exotic and native herbivores, the threat of competition from weeds and other natives, and interspecific competition. An investigation into the existence of any relationships with organisms such as mycorrhizal fungi, ants or insect pollinators also would be a worthwhile pursuit. Finally, targeted searches for populations must be undertaken in assumed suitable habitat to fully appreciate the extent of this species' distribution, and to provide further populations for study. Habitat modelling would assist to identify areas with high probability of presence for targeted searches.

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One Hundred Years Ago

The Mallee : Ouyen to Pinnaroo.

Botanical notes

By A.D. HARDY

Riding reluctantly away from Pink Lakes, we passed through fine savannah, well grassed and with a sprinkling of *Eucalyptus uncinata*, &c. Here the quandong trees bore fruit in plenty, and looked very ornamental. The quandong fruit is spheroidal, and at maturity the pericarp, reddish-coloured on the outside, is semi-succulent and sweetish and $\frac{1}{2}$ inch thick, enclosing a spherical nut with extremely hard, wrinkled, and pitted shell, of about $\frac{1}{4}$ inch diameter. This is *Fusanus (Santalum) acuminatus*. The Ming, Ming-Quandong, or Bitter Quandong, *F. persicarius*, differs in general appearance so slightly that it is difficult to discriminate, especially as the two rarely grow in the same locality,

the Ming favouring poorer ground than the Quandong. The chief differences appear to be in the palatability of the Quandong, and its smaller and more wrinkled and pitted nut-shell, as against the larger, smoother nut-shell of the Ming, coupled with bitterness of the pericarp. Bushmen, however, can at a distance identify either species, so there must be, to them, some marked difference in general appearance. The leaves of both are narrow lanceolate and more or less acuminate. The emu, which is an agent in dispersal of the seed, shows no favour to either species.

From *The Victorian Naturalist* XXX, p. 158, January 8, 1914

The name game

Having received the (dubious, some might say) honour of having a species of Australian frog named after me, I was led to reflect on some of the quirks and curiosities of the system which endows animals (and plants) with names dreamed up by scientists. 'My' frog is called *Uperoleia martini* (one of my colleagues instantly and unkindly remarked: Sounds more like a new kind of drink than a new kind of frog). In the description of the animal it is said to have 'moderately long hind limbs' and 'no webbing between the toes', which I can live with quite comfortably. On the other hand it also possesses 'a well-developed supracloacal flap' and 'cream patches in the groin', which are the kinds of thing you don't like even your closest friends to know about.

In fact, though, when an animal is named after a person, it is not because of any perceived resemblance; it is usually because the person either discovered the species or contributed in a significant way to knowledge of the particular group of animals. Thus, in this case, I have worked and published quite extensively on frogs in the genus *Uperoleia*. Similarly there are Australian frogs named for other biologists who have made important contributions to our knowledge of the frog fauna: *daviesae* for Margaret Davies, *littlejohni* for Murray Littlejohn, *spenceri* for Sir Walter Baldwin Spencer, *tyleri* for Michael Tyler, and so on.

I know of one case (no doubt there are more) where a mischievous describer used someone's name in a derogatory sense. In 1855 William Blandowski returned from a fish-collecting expedition to the junction of the Murray and Darling Rivers, and set out to publish descriptions of the specimens in the *Transactions of the Philosophical Society of Victoria* (later to become The Royal Society of Victoria). Dispassionate science? No—rather a vehicle for airing his grudges against members of the Society. *Cernua eadesii*, for instance, named in 'honour' of Dr Richard Eades, was characterised as 'a fish easily recognised by its low forehead, big belly

and sharp spine.' The scandalised members of the Society understandably ensured that publication was suppressed.

Species don't have to be named after people; indeed the practice is often frowned upon because such name derivations don't tell you anything about the animal itself. There are, as instances of more informative names, other species of *Uperoleia* called *crassa* (Latin, fat or heavy), *micromeles* (Greek, *mikros* small; Greek, *melos* limb), *rugosa* (Latin, wrinkled) and *trachyderma* (Greek, *trachys* rough; Greek, *derma* skin).

This practice may, however, be accompanied by pitfalls of another kind: does the chosen name provide an accurate description of the animal? Is *sapiens* (Latin, wise) really an appropriate designation for ourselves? The Swamp Antechinus is *Antechinus minimus* (Latin *minimus*, smallest), despite the fact that it is among the larger species in the genus. But it is much smaller than members of the genus *Dasyurus*, in which it was originally placed. There is an Australian tree-frog with the specific name *caerulea* (Latin: blue); in fact it is bright green. It turns out that it was described on the basis of an alcohol-preserved dead specimen, and in preservative the green fades to grey-blue. Yet another Australian frog, *Limnodynastes tasmaniensis*, is indeed found in, but is by no means restricted to, Tasmania.

Despite the rigid set of rules that governs the whole business of genus and species names, ingenious taxonomists do find ways to play games with them. The mosquito genus *Aedes*, renowned for its irritating bite, includes among its species *tormentor* and *excrucians*; there is a Canadian biting fly that goes under the name *Chrysops cursim*. In happier vein, English hemipteran specialist George Kirkaldy coined the Greek-sounding term *chisme* (pronounced 'kiss me') and built a seductive series of bug generic names on it, including *Polychisme*, *Marichisme*, *Dolichisme*, *Peggichisme* and the all-embracing invitation *Ochisme*. And, believe it or not, there is an Australian sphecoid wasp

called *Aha ha*. The story goes that in 1977 John Evans (then Director of the Australian Museum, Sydney) sent some wasp specimens to an American colleague and wasp researcher; on inspection of the contents of the package the recipient reportedly exclaimed 'Aha! A new genus of wasp!' There turned out to be two species present which he duly named *Aha evansi*, in honour of the sender; and (never one to let a glorious opportunity go by) *Aha ha*.

If, in the spirit of the game, you try to track down the longest scientific animal name of all time, you'll come up with a small, shrimp-like crustacean that lives in Lake Baikal and is called *Brachyuropuskyodermatogammarus greivlingwmnemnotus*. As far as my Greek and Latin go, it's the 'crustacean with a short tail [and] feet [found on] a dog's skin, [named] in memory of W. Greivling'. I haven't been able to verify this name and in any case I'm not impressed: surely it's just a transparently jokey attempt to create the longest and silliest name possible. On the other hand, I do have a soft spot for the shortest name on record: *la io*, an Asian bat. *la* was a beautiful maiden in Greek mythology; *io*, a priestess who became one of Zeus' lovers (as well as being a moon of Jupiter). Writing at a time before political correctness became obligatory, the describer, Oldfield Thomas (1902), explained that use of the names recognised that young women and bats are equally flighty creatures.

And one more element of the name game can produce some oddities. The full scientific name of each creature also includes the name of its author or authors—that is, the person or people who described it—and the year in which the description was published. Thus the *absolutely* complete name of 'my' frog is *Uperoleia martini* Davies and Littlejohn, 1986. The green frog that we met earlier was described by a John White, adding yet another hue to its green/blue confusion. But my current favourite is to be found in *Acta Geologica Sinica* (2012), where the description of a new genus and species of pterosaur, *Moganopterus zhuiana*, is to be found. Four authors take joint credit for discovery and description of this fossil reptile, and their names are Lü, Pu, Xu and Wu. What a shame they didn't also describe *la io*!

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One Hundred Years Ago

The Mallee : Ouyen to Pinnaroo.

Botanical notes

By A.D. HARDY

On ascending a small sandy rise of the better sort we looked down into a depression, and were astonished to see a lake of fair size surrounded by low sand-hills, and bright pink in colour, rendered more conspicuous by the green of the pines, quandongs, sandalwood, cabbage, and the rest of the group previously mentioned, and which almost surround the lake. There are four of these lakes close together, and the fact that they are situated at a spot where on old maps "Salt Lakes" was recorded, suggests that the lakes were known before, but were not then pink. The colour is in the salt, not in the water, as far as one could judge. A small quantity of the shallow water appeared colourless as a similar quantity from "the deep blue sea," and seems due to chemical impurity in the salt, and not to an organism, such as a microscopic alga. At the leeward side of the larger lake a fringe of drowned insects—mostly Coleoptera, and containing "lady-birds," &c.—marked a ripple limit, beyond which was a strip of wet pink salt. Outside this was a belt of dry, almost white salt, but with intense pink showing at any fracture or vent, and then mud and sand, salsolaceous plants, and grassy slope up to the edge of the depression, where grew a variety of trees already named and Mallee eucalypts.

From *The Victorian Naturalist* XXX, p. 158, January 8, 1914

Kerfuffle in the tree tops

While staying at Thurra River in Croajingolong National Park, my wife and I with two friends witnessed one of the best nature events of my 70 years. It occurred on 30th November 2013. My lady friend and I are both keen birders and we became interested in unusual calls coming from an acacia sapling of about 4 to 5 metres and quite close to our camping spot. When we investigated we were surprised to find that the calls were coming from several Yellow-faced Honeyeaters. They were making soft whimpering type noises that we had not heard before. My friend then observed a large snake (Fig. 1) about two metres up the tree. The snake was trying to reach out to a nest. At this stage, we were unsure of what species it was.

We watched as the snake tried to manoeuvre along a quite slender branch to the nest. The snake could not place much weight on the branch so it kept the bulk of its length attached to the trunk and gradually extended itself towards the nest, partially elevating itself as it stretched out. After about five minutes, it

managed to take a large chick from the nest and then spent a couple of minutes devouring it.

The snake then had to extricate itself from the tree. Its first attempts were to try and double back on itself to the trunk of the tree. It tried this for several minutes without success. It then extended itself as far as possible from the trunk and hung towards a lower branch. It swayed and searched again for several minutes until it simply dropped to the ground (Fig. 2), the branch below it breaking its fall sufficiently to prevent any injury. Now we were able to clearly identify the reptile as a Tiger Snake of between 1.5 and 2 metres in length. We shepherded the snake some metres from our camp where it curled up under some bushes for a well earned rest.

This whole event probably took in excess of 20 minutes and kept us and another nearby camper quite enthralled.

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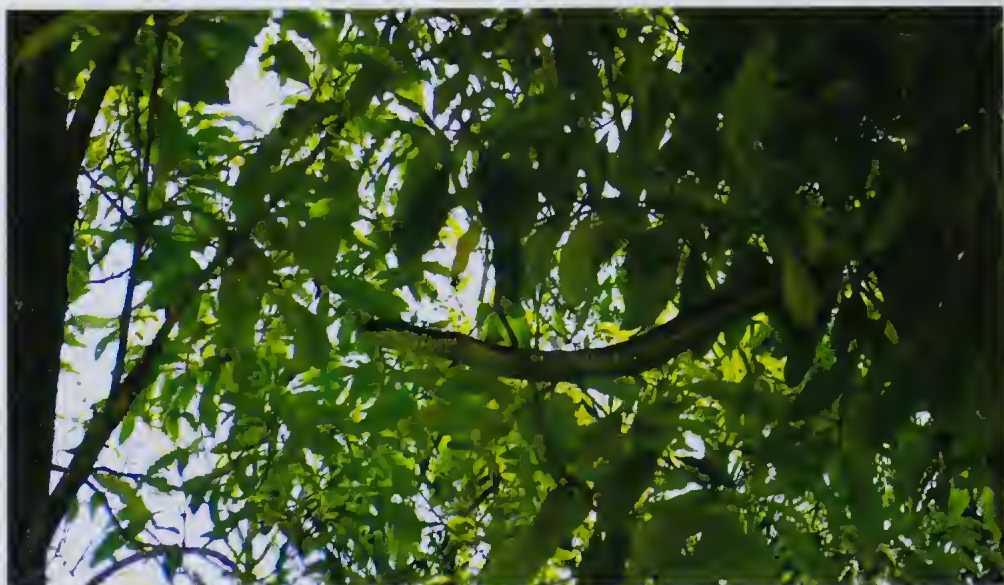


Fig. 1. Tiger Snake hunting in the tree tops.



Fig. 2. Tiger Snake after a successful hunt.

Bird's nest in birdbath!

On 13 January 2014, while walking with my six-year-old grandson near the eastern end of Normanby Road in the Melbourne suburb of Notting Hill (Melway map 70 J10), we found a bird's nest on the footpath near a eucalypt. The nest was made of thin strips of bark and lined with a white, fluffy synthetic material. I put it in our 'collection bag of interesting items', brought it home, and later left it on the ground in our garden. The next day, when I went to refill one of our birdbaths, I was surprised to find the bird's nest soaking in it.

I took the nest out of the birdbath and put it back where I had left it the previous day. On 8 February 2014, I found what was left of the nest in the same birdbath, and this time took the opportunity to photograph it (Fig. 1).

Two Little Ravens visit this birdbath regularly, often bringing pieces of bread, and occasionally bones, which they soak in the water. They are the only creatures in this area that would be likely to transport the nest to the birdbath, and presumably did so because they thought the white synthetic material might be edible when soaked. The distance between the birdbath and the place where I had put the nest is 2.8 m, and the bath is 300 mm above the ground. The nest was very light in weight.

Soaking food in birdbaths is a common behaviour in corvids and has been reported frequently (e.g. Inglis 1991; McMillan 1992; Slee 1992; Reid and Reid 1996; Slee 1996; Mackenzie and Mackenzie 2008), but to date I have found no reference to corvids soaking a bird's nest.

Savage (1995: 2–3) gave an interesting account of a crow that took water to its food, rather than food to the water:

In the late 1960s, a ... crow lived at the Allee Laboratory of Animal Behavior at the University of Chicago, where ... it was fed partly on dried mash which its keepers were supposed to moisten. But sometimes (being merely human) they forgot. The crow, undaunted, would then pick up a small plastic cup that had been provided as a toy, dip it into a water trough, carry the filled cup across the room to the food and empty the water onto the mash ... The bird had not been taught to do this.'

At our birdbath, bones and bread are again the order of the day.

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Fig. 1. Remains of bird's nest soaking in birdbath.

Fur Seals and Sea Lions

by Roger Kirkwood and
Simon Goldsworthy

Publisher: CSIRO Publishing, Collingwood,
2013. 160 pages, paperback, colour plates,
ISBN 9780643096929. RRP \$39.95

When I first opened Kirkwood and Goldsworthy's *Fur Seals and Sea Lions*, I had intended to do little more than flick briefly through its pages, perhaps taking a glimpse at the Table of Contents. An hour later, I found myself thoroughly engrossed. Roger Kirkwood and Simon Goldsworthy know their pinnipeds (seals), and both have published extensively on this group of marine mammals. Here, they focus on otariids (fur seals and sea lions) that breed along the coast of southern Australia, though species that breed in Australian subantarctic and Antarctic territories also are described briefly.

The book draws on recent research and historical information to provide a fascinating summary of the history, ecology and physiology of southern Australian seals, as well as the factors, both potential and realised, that threaten them. The introduction in Chapter One presents a brief account of the discovery and subsequent decline of seals due to harvesting in the region, and describes the marine habitat of southern Australia. Chapter Two summarises the evolution, taxonomic history and harvesting of seals. An absorbing discussion of morphological and physiological adaptations to the challenges posed by life in the marine ecosystem is presented in Chapter Three, while Chapter Four provides descriptions of the various species likely to be encountered in southern Australian waters. This chapter equips the reader with the necessary information to aid in seal identification.

The reproductive biology of the various species is well covered in Chapter Five. Here, the behaviour and reproductive physiology of both pups and adults during the breeding, pup provisioning and weaning periods are discussed in detail, including the asynchronous, extended



breeding period of Australian sea lions, and theories behind its evolution. Chapter Six describes the diets and foraging strategies of the three species, as well as methods needed to study these parameters, even including photos of the identifiable ear bones of fish that are recovered from scats in dietary analyses. Similarly, the challenges presented in estimating population size and trends are included in a discussion of otariid population biology in Chapter Seven. In this section, population trends are inferred from historic and current information, and an interesting section on population genetics is included. A discussion of the role of pathogens and parasites in regulating seal populations leads nicely into the final chapter on the conservation and management issues facing southern Australian seals.

Fur Seals and Sea Lions is written mainly for the interested layperson, though some sections assume a degree of background biological knowledge. The book is generally well written and structured, with subheadings allowing the reader to quickly identify particular sections of interest. However, the book's main strength lies in the variety of topics it covers. It answers

many of the questions I have asked over the years and even some that I had yet to realise I had—until their answers were revealed in the book. The comparison of otariid morphology is extremely useful to all who have ever wondered which species of fur seal they have encountered.

Grey-scale figures and tables scattered throughout the book enhance the discussion in the text but the colour plates near the end of the book are particularly appealing. These illustrate well the information provided in the text, and are at once fascinating and confronting. They include photos of seals at play on land, in the water and beneath the surface, a visual comparison of different age and sex classes of the three species, and the birthing of a pup. One

plate even offers a rare glimpse of an Australian sea lion instrumented with a crittercam at sea. Several photos of seals entangled in a variety of materials reinforce the impacts of humans on seals, and some of the issues facing the conservation and management of these charismatic marine animals.

Overall, I found this book thoroughly enjoyable; it was easy to read, relevant and engaging. It would complement any natural history library and I recommend it to anyone with an interest in marine mammals, as well as anyone without—this book will surely pique the interest of even the most indifferent reader.

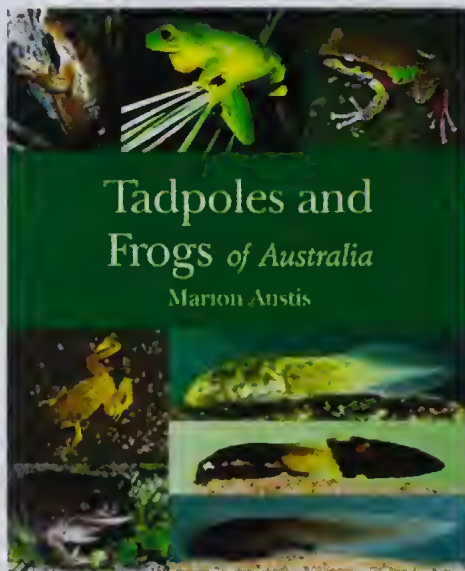
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Tadpoles and Frogs of Australia

by Marion Anstis

Publisher: New Holland, Sydney. 2013.
831 pages, hardcover, colour photographs,
monochrome technical drawings, ISBN
9781921517310. RRP \$125 (\$145 for the
limited edition, ISBN 9781921517167, signed,
individually numbered)

Few natural processes engage the young (and not-so-young) budding zoologist as much as the triphasic lifecycle of a typical frog. From egg to tadpole to young frog, many have watched in wonder. So it is a little surprising that guides to Australian frogs typically provide only cursory mention of the eggs and tadpoles of each species. That changed around a decade ago when Marion Anstis produced the first definitive guide to the eggs and larvae of a cohort of Australian frogs: *Tadpoles of South-eastern Australia: A Guide with Keys*. Although that book 'raised the bar' for amphibian field guides in this country, Anstis was not satisfied by either the modern crop of frog books, or even her own seminal work. She was determined to produce a book that covered in detail all lifecycle



phases of *all* Australian amphibians—a monumental task! *Tadpoles and Frogs of Australia* is the culmination of that vision. This book is not intended to be a field guide—it is a full-blown, comprehensive reference book, and has the physical stature to match. It is wonderfully large and heavy and, in an era of e-books and online publications, for a bibliophile like me this tome

is as much a joy to hold as it is to behold! It won't fit in the glove-box of most vehicles, and it will quickly tire the fittest fieldworkers should they carry it into the field—although I have no doubt that many keen herpetologists will have this book on the back seat of their field vehicle.

As well as the usual preliminaries, including a glossary (which is a necessity—I certainly didn't know the meaning of 'nidicolous!'), the book is divided into three parts. Part 1 'Preliminary background' commences with frog classification, before detailing the 46 developmental stages for aquatic tadpoles, from fertilised egg to fully metamorphosed frog (as well as a separate section for those fewer species that develop in terrestrial or semi-terrestrial environments). The collection and raising of eggs and tadpoles is explained, and predators of tadpoles are described. Conservation issues relevant to amphibians are covered—a pressing topic in an era of catastrophic losses and declines of amphibians. Conservation is a theme repeated throughout the book, and Anstis can rest assured that this book will be an immensely valuable tool for conservation biologists throughout Australia.

Part 2 'A look at features' provides detailed coverage of morphology and features for each of the lifecycle phases typical of frogs, and includes the oral disc, an important diagnostic feature of many tadpoles. A key to the genera of tadpoles is included, as is a guide to the types of egg clusters. The key is necessarily technical, but it is underpinned by matching explanatory detail throughout the book, and the guide to egg clusters—accompanied by photographs of the 23 types—is enormously valuable for identifying species or genera when adults and tadpoles are not conspicuous, or cannot be observed closely, at breeding sites.

Part 3 'Life histories' contains identification keys for the eggs and tadpoles of each genus, followed by meticulously detailed profiles of most species of Australian frogs. Rather than selecting a random profile to describe here, for sentimental reasons I turned to a species named in honour of Victorian frog legend Murray Littlejohn. The profile of *Litoria littlejohni* contains

three photographs of adult frogs, photographs of the lateral, dorsal and ventral surfaces of the tadpole, another of the tadpole's mouthparts, photographs of an egg cluster and a juvenile frog, and beautifully detailed technical drawings of the tadpole and its mouthparts. There is a distribution map, which details breeding sites of *L. littlejohni*, a description of the adult frog, and seasonality and type of mating call. Embryos are described, including the type of egg clutch (referenced to the earlier egg cluster guide), followed by descriptions of the ovum, capsule and hatchlings. Tadpoles are described, including size and detail of the tadpole's body and oral disc. Seasonal timing of metamorphosis is provided, along with a description of the behaviour of tadpoles. Finally, there is a section to help differentiate between similar species. Incredibly, this coverage is extended to a further 214 species! This is slightly less than the total number of described Australian frogs (241); the remainder are species for which relevant information was not available at the time of writing.

The publisher tells us that there are 3060 photographs and drawings; I did not try to verify this, but there is no question that every topic and species is illustrated with high quality images. The retail price is not a trifling amount, and before I saw this book I wondered whether it would be worth the outlay. Having had time to appreciate the quality, scale, scope and usefulness of this book, I believe it is actually a terrific bargain. Is the book flawless? Of course not. But pointing out rare (and very minor!) typographical errors feels a little like noting an errant paintbrush hair on the ceiling of the Sistine Chapel. In short this is a landmark book by a remarkable natural historian and scientist. It is an instant classic, and the new bible of Australian frogs.

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